Task 1.3.2
Externalities

Managing Externalities: Opportunities to Improve Urban Water Use

Mike Young
Policy and Economic Research Unit

CSIRO Urban Water Program

Our Ref: Folio 01/1324

Urban Water Program

CSIRO

PERU

PREFACE

This report has been prepared under contract to the CSIRO Urban Water Program that is ably led by Andrew Speers. During its preparation, I have had the opportunity to work closely with the Program's Project Managers. The innovative work they are leading suggests that it is technically feasible to significantly improve urban water use. The technical opportunities are many and a significant number appear to be affordable. The policy focus of this report is on opportunities to make it feasible for some to be realised in a cost-effective manner.

Preparation of this report has been assisted by many people who supplied documents and background information. Their contribution is acknowledged with gratitude. In particular, I would like to thank my fellow economist John Bowers for his ability to help me think through some of the conceptual challenges that underpin this report and Stephen Gray for some useful insights from the perspective on an engineer. I would also like to thank Sharon Rochow for her ongoing and loyal support in times of need.

PERU

Mike Young

MANAGING EXTERNALITIES: OPPORTUNITIES TO IMPROVE URBAN WATER USE

PERU

Introduction

Australia is entering a new era for water management. There is considerable demand for improvement in the quality of water resources. In almost all areas where there is significant human population, there is no more capacity to increase the contaminant load. In some areas, assimilative capacity has been exceeded. The challenge is to find ways to accommodate more people without increasing the volume of pollutants that each person puts into stormwater and sewage systems. Where the total load can be decreased, significant social, economic and environmental benefits can be anticipated.

The volume of water used in urban systems also requires attention. A recent report on Water and the Australian Economy, observes that "policies are needed to ensure that the resource is managed as a totality, including groundwater, unregulated rivers and water quality. Water trading must operate in a system of regulation which ensures that individual trades do not impose external effects on third parties" (AATS&E 1999). In the Murray Darling Basin, the volume of water available for consumptive purposes has been capped. The search is for more efficient ways to use and re-use those resources we have. Focusing on externalities, this report is about opportunities to improve water use and quality in a cost-effective and politically acceptable manner.

Externalities

The concept of an externality comes from economics. **An "externality" is economic jargon for something that influences the welfare of individuals or a community through a non-market process. There is no market feedback from the person who experiences the loss or gain to the person who creates it** (see Figure 1)**.** Costs and values are not revealed and, hence, not taken fully into account in the production process (Bowers 1997). The system, however, is not as imperfect as some people may consider. A large array of regulatory, community and political processes are used to reveal the cost and value of externalities to water users.

One well-known example of an urban water-use externality is the disposal of partially-treated sewage into an estuary or ocean. Any resultant reductions in bathing or surfing opportunities are defined as an externality. The welfare of those who produce and release the sewage into the outfall remains the same no matter how many people surf since there is no market feedback processes between these two interdependent activities.

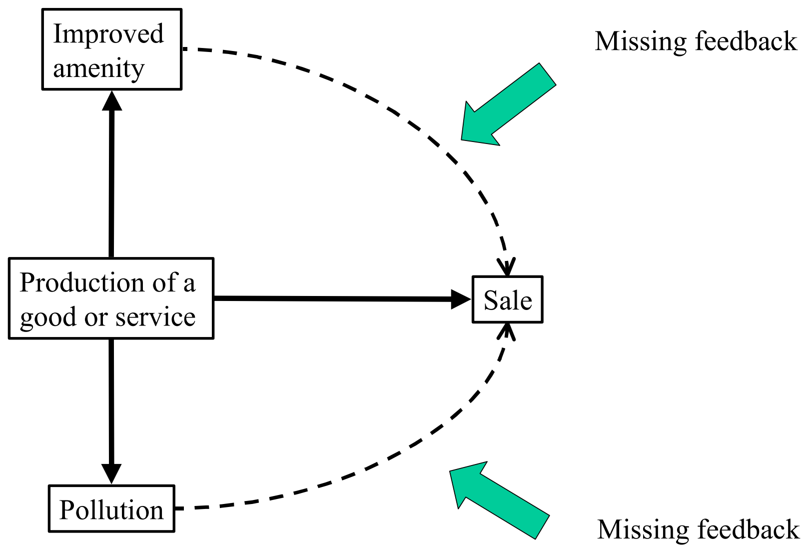

Figure 1 Economic model of showing the nature of an externality. The sale price includes no adjustment for the value of improved amenities or the cost of pollution

Positive and negative externalities

The theory of externalities

It is useful to distinguish between actions that improve people's welfare and those that detract from it. A *pure positive externality* is one that increases at least one person's welfare and does not detract from anyone else's welfare. Conversely, a *pure negative externality* is one that decreases at least one person's welfare and makes no-one better off.

In practice, few pure positive externalities and few pure negative externalities exist. In most cases, the best we can do is talk about externalities in "net" terms. The construction of a dam, for example, can both reduce the value of a wetland and increase the value of recreational opportunities.

The benchmark for defining what is negative and what is positive depends upon definitions of individual rights to use the environment and natural resources. Often the benchmark chosen is the status quo. For example, if water is returned in a cleaner state than it is removed then this action is defined as a pure positive externality. If the returned water is more contaminated than it was when extracted from the natural system, then this action could be defined as production of a pure negative externality. This is the way most economists define externalities.

The practice

PERU

Generally, use rights and obligations are defined in legislation, regulations and catchment management plans. Real property arrangements and license conditions also affect such definitions, as does common law. Collectively, all these mechanisms define each person's duty of care for the environment. **Duty of care for the environment is a term gaining gradual acceptance in rural areas.** [1]

Duty of care is a new concept for urban water users.[2] Often the implied definition of duty of care suggests some degree of social acceptance and tolerance of practices that degrade the environment. Water users are allowed to create some 'negative' externalities but not too many!

As there is no market for the production of externalities, complex community consultation and planning processes are used to define duty of care. Acceptance of a duty of care benchmark means that any activity that produces an outcome above this standard is a positive externality. Duty of care, however, is not a static

---

1 Under some measures of welfare, the money so collected should be used to compensate the people impacted by the negative externality so that no person is made worse off as a result of its imposition.

2 The idea of duty of care for the environment was developed by Binning and Young (1998) and has since been given wider currency by the Industry Commission (1998).

concept. In particular, management plans often propose to change the way duty of care is defined. Most catchment management plans suggest an expectation that standards will be raised through time and raised without payment of compensation. For example, the discharge of secondary treated sewage to many river systems was considered acceptable until algal blooms became common. Now, in many areas, tertiary treatment is required.

Duty of care is an evolving concept (Figure 2). **Catchment Management plans can define duty of care as a set of minimum water quality objectives that all users must pursue. This means that positive externalities may *initially* be most appropriately dealt with through the use of positive price signals but, at some stage in the future, be more appropriately managed via the use of negative price signals.** Further explanation is necessary to clarify this point. To speed adjustment, initially, people causing the externality might be paid an incentive to encourage them to change practice. After an appropriate period, however, all might be expected to adopt the preferred practice. When compliance becomes a duty, those who do not comply should be penalised via the imposition of levies, fines, etc.

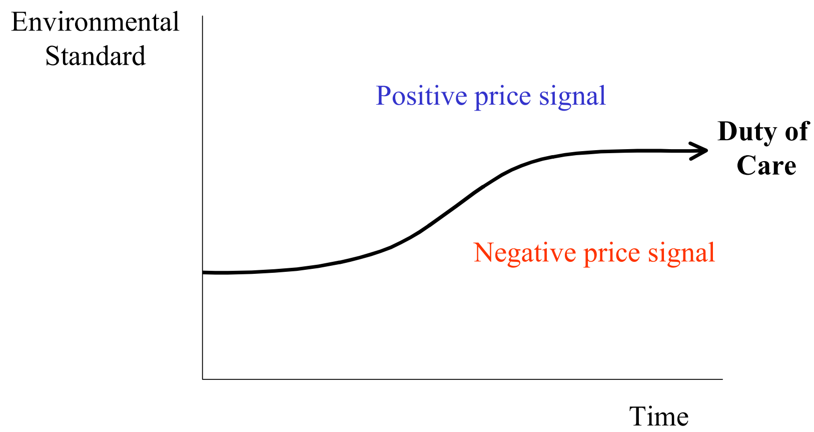

Figure 2 Dynamic nature of the distinction between positive and negative externalities. Actions defined as positive today may be defined as negative tomorrow

PERU

Figure 3 summarises these concepts by presenting an externalities meter. The gap between costs currently imposed on water users and duty of care indicates the extent of negative externalities. The gap between duty of care and the policy target represents the extent of positive externalities.

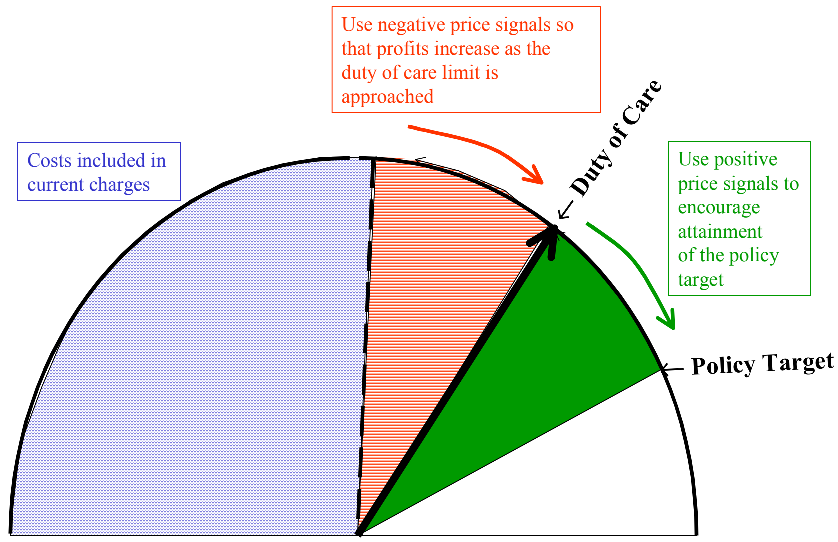

Figure 3 A "meter" showing the proportion of costs included in current charges, the increase necessary to fully cost negative externalities as defined by definitions of duty of care and reimbursement arrangements necessary to deliver a policy target defined through community consultation processes[3]

Urban water externalities

Surprisingly, there has been no review of the nature and extent of externalities associated with urban water use in Australia. Much of the relevant information, however, can be found in state of environment reports, in catchment management plans and in guidelines for the management of stormwater and sewage.[4]

---

3 This diagram is adapted from concepts developed by Dames and Moore-NRM when contracted to develop cost sharing rules for natural resource management.

4 Given this it would be timely for someone to commission a report on the extent and nature of externalities associated with water use in Australia.

The CSIRO Urban Water Program integrates water-supply, water-use, wastewater-return and stormwater considerations. From an engineering and system design perspective, this integrated approach simplifies water modelling. **From an externalities perspective**, however, **a more efficient and effective set of outcomes is likely to emerge if separate instruments are used to deliver each water supply, waste water and stormwater objective.**[5] Separation means that trade-offs among issues can be achieved efficiently through time. If knowledge about one issue changes then the instrument associated with it can be adjusted without consequence for other issues. As far as possible, this report separates the consideration of

- Water- supply, water-use and waste-water return disposal externalities
- from storm-water externalities.

Water-supply, use and return externalities

Conceptually, urban water-supply, water-use, and wastewater-return externalities occur at three locations:

- In association with dams and the streams, rivers and ecosystems they interfere with;
- In association with the built environment where water is consumed; and
- In association with the return of contaminated wastewater to the environment.

Water-supply externalities

Examples of upstream or supply externalities include both direct impacts at the storage site and, also, effects that storage has on the performance of river and groundwater systems. These externalities are generated, in part, by competing demands for water. The more water diverted into the urban supply system, the less available to support agriculture and to maintain valuable environmental functions. All water has an opportunity

---

[5] The Tinbergen Principle applies. For an institutional solution to remain dynamically efficient, each objective should be managed via a separate policy instrument so that one can be varied without having to change the other.

cost[6] and, in the absence of a competitive market for it, sometimes allocation to the urban sector may not be its highest and best use.

In–situ water-use externalities

In-situ water-use externalities tend to be associated with amenity values. A visually attractive garden, for example, could be defined as a positive externality, but there is a social expectation that there is no need to compensate people for the marginal cost of producing such benefits. The marginal cost of watering a large recreational area, however, may represent a community service that should be reimbursed. An example of a negative externality within an urban area, for which a negative price signals should be sent, may be the fear of the health impacts of "grey" water application to a garden. These are in-situ water-use externalities.

Waste-water return externalities

The range of return externalities associated with urban water use depends, almost entirely, on the extent of wastewater treatment and the way that water is disposed of. For example, the cost of return externalities associated from a well-located ocean outfall may be small even though the waste is only partially treated, but the cost of ex-situ externalities associated with wastewater returned to a river system may be high due to the limited volume of receiving water. In short, the magnitude of the impact of an externality can be expected to vary from location to location.

Stormwater externalities

Stormwater externalities, unlike water supply externalities, only have in-situ and downstream effects. Moreover, many of the externalities associated with stormwater management are caused by factors other than water use. A large proportion of stormwater contaminants, for example, results from processes not associated with water use. In cities, many of the by-products of motor vehicle use find their way into stormwater. Where this creates a problem, it may be more efficient to change the price signals given to vehicle

---

6 Opportunity cost is the value of the resources that are used in providing the water.

users than to try and send a signal indirectly by changing stormwater management procedures.

In-situ stormwater externalities

"In-situ" stormwater externalities express themselves through the effects on flows on stream, river, wetland and groundwater values and contaminant loads to the environment.[7] As summarised in a recent Western Australia report (Evangelisi Associates *et al.* 1998), there are many opportunities to convert negative stormwater externalities into positive ones. Open space recreation areas, for example, provide an attractive alternative to a concrete drain. Similarly, Melbourne Water has recently begun a process of using stormwater to create a series of urban wetlands.[8]

Ex-situ stormwater externalities

"Downstream" stormwater externalities express themselves via their effects on base and peak stream flows and the volume and nature of contaminants in receiving waters. Impacts on flow regimes are particularly important. Zinc contamination from the use of galvanised roofing, fences and poles, for example, is emerging as a serious stormwater contaminant.

PERU

Alternative classifications

Accumulative contaminants

Externalities can also be classified into those not involving contaminants, those involving contaminants that can be assimilated into their receiving ecosystems and those that accumulate through time. Litter poses amenity problems and can damage wildlife. Contaminants like nitrogen, phosphate and salt can be assimilated into most environments and, indeed, exist

---

7 Surface and groundwater systems are often interlinked. In some parts of Adelaide, for example, urban water and land-use practice can result in rising water table that can, in return, cause dryland salinity problems. In some urban areas, base stream flows are made up almost entirely of groundwater flow from shallow unconfined aquifers. Pollution of these aquifers from, excessive use of garden fertilisers, can result in significant contamination of urban water bodies such as Adelaide's River Torrens (Barnett *et al.* 1996).

8 As establishment is being funded from the Natural Heritage Trust, this should probably be defined as a positive externality.

naturally in most environments. Normally, however, their effects dissipate. Accumulative contaminants, like most heavy metals, however, have long term consequences that are neither easily valued nor easily reversed.

Sequential and nodal systems

Finally, the nature of the effect of urban water externalities and the methods necessary to manage them will vary according to the nature of downstream uses. Costs are likely to be quite different in systems where water is used sequentially from systems where use is nodal. The Murray Darling System provides an excellent example of a sequential water system. In sequential systems, water from one town is returned so that others can use it. Sequential systems have more receptors and more factors to be considered. As a result, the standards set for such systems are often higher. Issues like the additional costs of making water fit for human consumption and the costs that salt impose on urban infrastructure need to be considered. In "nodal" systems, like those used to supply Sydney and Melbourne, water is typically taken from a dam high up in a catchment and only used for human consumption purposes once. Water is used once then typically released to the ocean after treatment.

Effects of externalities

As indicated above, economists define externalities as an action that affects the welfare of people via a non-market process. From an urban water perspective, the range of welfare effects associated with an externality include affects on

- health (sickness and death);
- recreation opportunities;
- property values and opportunities to earn income;
- the cost of protecting property from adversity (defensive expenditure);
- amenity values; and
- environmental values associated, for example, with wildlife protection and the prevention of heavy metal contamination.

A methodology showing how these costs can be estimated has been provided in a separate report to the program (Bowers and Young, 1999). The presence of these externalities, however, means that governments and the community must monitor and manage them. Thus, for completeness, the costs of resource and environmental management should be included in any assessment of the cost of externalities.

Opportunities to improve the distribution of externalities

Having defined the nature of externalities, we can now explore ways to reduce the negative and increase the positive nature of them. The goal is to find a mix of policy instruments that will deliver the environmental outcomes set out in management plans at least cost. Conceptually, and at the most general level, the main opportunities lie with mechanisms that change values, reduce the total demand for water, or reduce the quantity of contaminants released into water bodies. It may be possible to improve the nature of return flows. The remainder of this paper focuses on opportunities to increase the incentive for people to bring about such changes. Five types of mechanism can be identified

- Informational;
- Motivational;
- Property-right;
- Financial; and
- Regulatory.

In practice, a mix of mechanisms will be used to achieve the optimal outcome in any location. Not all will be appropriate for all circumstances. Moreover, as behavioural and biophysical conditions change, the mix will need to be changed so as to continue to deliver an optimal outcome (Young *et al.* 1995; Gunningham and Young 1997).

Information

Virtually all environmental programs and incentive systems need to be underpinned by the use of a suite of information programs. Information mechanisms aim to improve understanding of biophysical and economic processes. ACTEW, for example, claims that one of the reasons for the success of its policy reforms is that they have invested heavily in communication and information programs. Changes in water charges were accepted because people understood that this would be cheaper than building a new dam.

In a parallel study to this report, Syme (1999) reports that community knowledge about the urban water processes is very limited. Where knowledge about the system is poor, perverse and unpredictable responses to incentive packages are likely. Consequently, **there may be considerable opportunities and dividends associated with improvement of the extent and availability of information about urban water sources and the impact of its use.**

PERU

One information mechanism, not yet used in the water industry, is a water efficiency rating system for houses. The closest example of such a system is the five star energy rating system now in use for housing in the ACT.[9] Introduced in 1998, this system classifies each house according to the degree to which it is designed to conserve energy. No house may be sold without first obtaining an energy rating and providing it to a prospective buyer. Essentially, the less glass, the more double glazing, the more insulation etc the higher the rating is. Conceptually, **a water rating system could be developed for urban water use.** The highest rating would be reserved for houses characterised by appliances, wastewater return, stormwater management and garden systems that minimise negative environmental impact. As with the ACT Energy rating

---

9 Energy Efficiency Ratings (Sale of Premises) Act 1997.

system, **regulations could require that no house may be sold without first obtaining a water rating and providing it to a purchaser before a contract is signed.**

Motivational mechanisms

Motivational mechanisms aim to change social behaviour by rewarding people who demonstrate best practice and are prepared to lead changes in attitude by example. Typically, they seek to influence community norms and perceptions of each person's responsibility to reduce the extent of urban water pollution. Often there is little difference between informational and motivational mechanisms. Surprisingly, motivational mechanisms have not been used widely as a means to improve stormwater and waste-water management. This is probably because water quality management is seen more as an issue that is the responsibility of government rather than community. Nevertheless, it is likely that programs like the "Tidy Town" competitions and "Keep Australia Beautiful" Campaigns have had a considerable but, as yet, unmeasured impact of the extent of negative externalities associated with urban water use.

PERU

Right-market mechanisms

Right-market mechanisms[10] are a subset of property-right mechanisms that change or introduce a restraint on market process. Many variants of right-market mechanisms exist. The list includes

- tradeable development rights;
- off-set mechanisms;
- tradeable emission quota;
- tradeable water rights; and
- some load-based regulatory systems like bubble licences.

---

10 Right-market mechanisms are often called property right mechanisms and economic instruments. These terms, however, are ambiguous. The characteristic that differentiates these instruments from all other instruments is the fact that they involve the transfer of rights to use the environment or a natural resource through a market process.

From an urban-water perspective, the main advantage of right-market mechanisms is the incentive they give water users and developers to search for ways to reduce externalities across the entire locality. In particular, they can be used to create incentives for people to reduce externalities associated with use in old established areas. Subjective opinion would suggest that it is often these systems, not greenfield sites, that produce the most externalities.

Off-set mechanisms

Off-set mechanisms allow increases in an activity provided any increase in the extent of negative externalities produced is off-set by a reduction elsewhere. They are best suited to situations where environmental or development capacity has been reached. Most operate by making development approval conditional upon the reduction of loads or flows elsewhere. Their advantage over tradeable emission rights is that they can be tacked onto existing regulatory processes for little additional cost. In particular, once the implementation of the off-set has been verified often there is no need to set up a monitoring system and no need to allocate rights to existing users.

PERU

An emissions off-set system, for example, would be well-suited to situations where there is benefit in reducing stormwater run-off (Young 1994). Under such a scheme, any person who wishes, to extend their house would need to arrange for the removal of some sealed area nearby so that the aggregate amount of run-off would stay the same.

An operational example of such an off-set system can be found in Hessen, Germany where a quite complex suite of off-set arrangements are used to reduce the costs that urban development imposes on five environmental problems. Stormwater run-off is one of these. Aspiring developers are given the choice between paying for the marginal cost of expanding the storm-water system (presumably including the cost of all externalities) or arranging to off-set the impact of their proposed development on the storm-water flows. Given the choice, most developers prefer to find ways to off-set increases in the impervious area and or run-off (Young 1992). Impervious parking areas are being replaced with pervious ones, roof run-off is being diverted to garden ponds, and roads are being narrowed. The result has been an increase in urban density without an increase in stormwater run-off.[11]

In United States of America, off-set mechanisms are being used to reduce nitrate and phosphate pollution. This is achieved by estimating the expected increase in contaminant flows from development proposals, such as a proposed sewage treatment works, and then requiring this increase to be off-set. Often the result has been a number of what are called 'non-point source to point source' trades. Typically, a sewage treatment plant is allowed to off-set a proposed increase in emissions by producing a two or three fold reduction in contaminant flows from non-point sources like a dairy. The result is a significant improvement in water quality at no cost to taxpayers (Young and Evans 1997).

PERU

The main advantage of off-set mechanisms is that they provide a strong incentive for people to search for cost-effective means to retrofit existing installations. They avoid allowing the situation to deteriorate and encourage the resolution of old problems so that new opportunities can be pursued. Furthermore it is the developer, motivated by the desire to control costs, who seeks the solution, rather than the regulator. This means that off-set mechanisms are economically efficient.

Most off-set mechanisms include a "no backsliding provision." No backsliding means that the standard building regulations still apply. The mechanism cannot be used to get around an existing regulation.

In Australia, **off-set arrangements could be applied at either the individual development proposal level or at the local government level**. Linked to the development approval process, off-set mechanisms could be used to create a strong incentive for people to reduce negative externalities. All urban expansion, for example, could be made conditional upon off-set arrangements that would apply across any part of the entire catchment. The catchment could be defined to include either the

---

11 A system similar to this has been proposed for Melbourne (Young 1994).

immediate agricultural hinterland or, possibly, a much larger area. The main attraction of a mechanism like this is that it would provide all developers and councils with an incentive to reduce stormwater run-off from existing areas.

Similarly, off-set arrangements for nitrate and phosphate could be introduced for a region, like Ellenbrook (the test case site used for the UWP), where nutrients from all sources are thought to account for around 30% of the nutrient load for the Swan River. Any development anticipated, that is expected to increase the total nutrient load to the Swan River, would be required to off-set that increase. Two options would be possible, a 'one for one' point source exchange or a 'two for one' non-point source for point-source exchange.

Load-based licensing

Typically, firms and waste water treatment plants obtain a licence to dispose of contaminants into water bodies, the air or in land fills. These pollution licences usually specify the type of equipment that may be used. Maximum concentrations are often specified. **Load-based licensing** takes this process one step further and **places limits on the total quantity of pollutants allowed.** The sum of the limits in all licences can then be managed and debated as a policy target. **Load-based licences provide the information stream, and establish the database, for many of the other instruments described in this report. Load-based licensing is a precursor to the introduction of tradeable emission right systems and emission charges.**

Not surprisingly, the introduction of load-based licensing is being routinely recommended as an appropriate way to reduce externalities associated with urban water use. Recent examples of such recommendations include COAG (1999), Brunton (no date), and PriceWaterhouseCoopers (1999). Load-based licences seek to make polluters aware of the total load they are placing on the environment and, also, to cap emissions within acceptable limits. Interesting examples of load-based licence arrangements are now emerging across Australia. In Victoria, a pollution loading index has been introduced and a two-part charging system, with one part set in proportion to the load index. Innovatively, the charge is reduced for licensees accredited as using best environmental practices (PriceWaterhouseCoopers 1999).

A major issue for all load-based licensing systems is the question of who should hold the licence. In areas like Ellenbrook, a household licensing system would probably be too expensive to administer but with the emergence of smart monitoring technologies, nodal licensing systems could be introduced at the estate level. Each estate would be licensed to add not more than a specified load of pollutants to the system. Collectively, the load from each estate or node in the collection system would add up to the total load permitted for the Ellenbrook region. The result would be an incentive for each estate to seek ways to reduce total contaminant loads to the waste-water and storm-water system.

Load-based licensing also facilitates to the introduction of bubble licences. Typically, a bubble licence stipulates that the total load of contaminants is fixed but, within the area they control, the holder of a licence is free to change the source of this load as much as they want. Introduction of load-based licences, especially their specification as regional bubble licences, would create strong incentives for people to search for new ways to reduce the contaminant load. In the Ellenbrook region, each council area could be allocated a load-based licence and then left to find ways to keep emissions within their total allocation. Trading among councils could be permitted.

Introduction of load-based licences is also the first step toward the introduction of tradeable emission-right systems. These systems are quite complex to establish and have only been used in Australia to control salt loads.[12]

Tradeable water rights

As a result of the COAG water reform agenda, irrigators throughout Australia are beginning to trade water rights. These licences entitle their holder to extract a specified volume of water each year. Both annual allocations and

---

12 For a discussion of their merits and there application to other problems see James (1997), Young and Evans (1997), Young (1994) and NSW (1998).

the right to receive such allocations are now being bought and sold. As a result, water is becoming a valuable commodity. Rapid structural adjustment is beginning to occur. **One of the consequences of the introduction of tradeable water rights is that water users are now searching for alternative, cheaper sources of water. As a direct result new markets for grey water and, even, for stormwater, are beginning to emerge. One outcome has been the emergence of a new set of disputes over property.** In the past, virtually all urban water, after appropriate treatment, was returned to river, estuary and oceans as a free good available to other users and the environment. Now that water can be sold, some sewage treatment plants are seeking opportunities to sell treated effluent rather than return it to the system it came from. Throughout much of the Murray Darling Basin, for example, the sale of effluent water to irrigators is an expanding activity. Similarly, SA Water is selling increasing amounts of treated effluent to market gardeners on the North Adelaide Plains. From an externality perspective, the introduction of tradeable water rights of this form means a reduction in contaminant flows at no cost to existing users.

Another interesting example of the impact of new water trading arrangements and increased prices, is the creation of artificial wetlands that "clean" stormwater and then use this water to recharge wetlands. In Adelaide, the institution that is doing this has been granted a licence to extract part of the returned water for irrigation in the following summer.

Pricing opportunities

Pricing policy has a number of functions. First, pricing policies can be used to signal the importance of taking account of externalities. Second, they can be used to internalise the cost of externalities in an attempt to make water use optimal. Third, via voluntary arrangements, they can be used to re-imburse people for the cost of providing positive externalities. Throughout much of Australia, urban water pricing arrangements are also used as a means to tax land-users and to redistribute income.

Signaling negative externalities

As a recent COAG paper on incorporating externalities into water pricing[13] observes "**even a nominal environmental charge in water pricing regimes would convey a strong message to water users**." Pursuing this reasoning, several States and Territories have introduced levies and charges for discharges into the environment. Most of these environmental levies seek to signal environmental responsibility and, as far as we are aware, are not intended to fully internalise the cost of externalities. Examples of recent signalling initiatives include

- South Australia's load-based fee structure for point-source discharges into all waters; and
- Victoria's combined flat fee and load-based fee system for licensed discharges into waters (Brunton undated).

The South Australian system is based on a sophisticated formula where the fee payable is calculated by formula that multiplies flow rate by salinity factor by pollutant class by an area impact factor.[14]

PERU

NSW is in the process of introducing a complex load-based licensing system. As yet, however, no state has introduced a load-based fee system for sewage effluent disposal or stormwater disposal at either the estate or the household level.

Full-cost pricing

In 1994, COAG developed a water reform agenda recommending that all states and territories begin a transition to full cost recovery for water use. Cross subsidies are to be removed and water rights are to be separated from land title. Full cost recovery is defined to include environmental costs and is generally assumed to equate with what economists define as lone-run marginal cost. At the end of the transition

---

13 COAG 17th Meeting, 2 July 1999 Agenda Item 3c (ii). The paper recommends endorsement of nominal charges. The paper sees a need for two types of charge. A Resource Management Charge and an Environmental Charge.

14 Environment Protection (Fees and Levy) Regulations 1994 - Schedule 3 process, the proposal is that water pricing regimes in all States and Territories should reflect the situation set out in Figure 4. All States and Territories are now in the process of moving toward such an arrangement. In many areas, however, water charges are still less that the full cost of supply. To improve externalities, either prices must be raised, subsidies for alternative processes must be introduced, or changes must be forced through regulatory and development control processes.

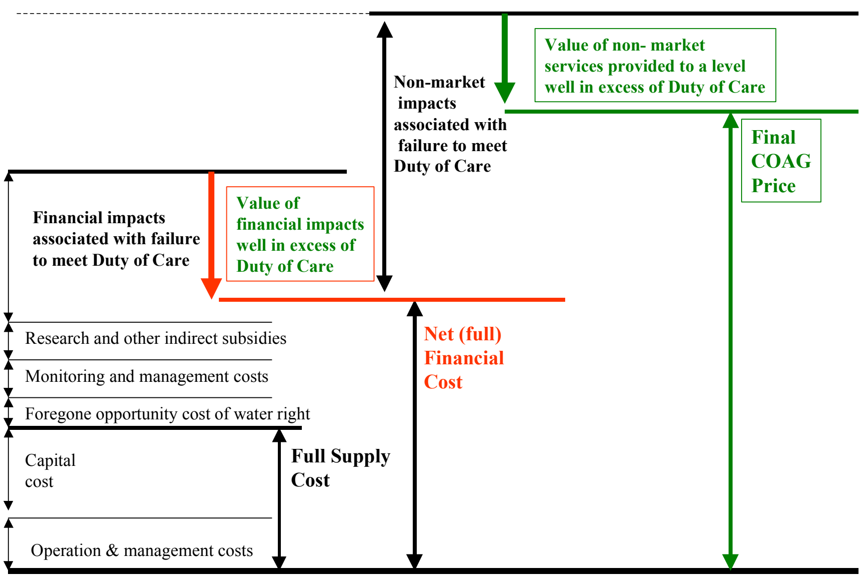

Figure 4 An overview of the final water pricing regime endorsed by COAG[15]

As a general rule, the introduction of full cost pricing mechanisms is likely to significantly modify urban water use. There are two options that can be followed as full cost pricing is introduced. It is possible to introduce

---

15 Water trading will reduce the opportunity cost of water use to zero. Although not yet incorporated into COAG literature, economic discipline would suggest a need to include the cost of government support for research and development on water resource issues in any attempt to measure the full costs of water use. The benchmark for determination of whether or not an externality is positive or negative is that defined as the duty of care in each catchment plan.

- general environmental levies and resource management charges; or
- sophisticated charging systems that provide problem specific incentives to reduce negative externalities.

Whichever approach is taken, the result is likely to be a significant improvement. In the Hunter Valley, for example, the simple introduction of a two part tariff that recovered supply costs reduced average annual water use from 300KL per household to 220KL per household (James 1997). In combination with emission charges and tradeable emission licences, a similar improvement in the extent of negative externalities could be expected. Negative and positive externalities need to be considered separately. As indicated in Figure 4 and Figure 2, positive price signals are needed to generate an optimal supply of positive externalities.

Charging for negative externalities

As a general rule, the more closely these fees align with the source of the externality, the greater the effect on negative externalities will be. Obvious opportunities to reduce negative externalities include introduction of nodal charging systems. **Nodal charging systems use smart metering and monitoring techniques to levy users in proportion to the load at each point in a sewage system.** Each group of water users then has a financial incentive to search for ways to reduce sewage treatment costs and the total load of contaminants returned to the environment. It is significant that, in cases where nodal and point source charging systems have been introduced, trade-waste disposal industries have emerged as companies begin to search for ways to dispose of waste that are cheaper than dropping it into the sewage system (James 1997, Brunton undated).

PERU

When recommending full-cost pricing mechanisms, emission charges etc, it is important to assign them so that their incidence encourages improvement. **In the case of stormwater pollution**, for example, **the first best solution may be to charge motor vehicles and people who use galvanised metal rather than simply levying all users.** In other cases, it may be more efficient to place a levy on detergents. The revenue collected from environment levies of this kind could then be returned to those whose actions reduce stormwater contamination in a manner that creates a new business opportunity for urban water managers.

Finally, where direct metering of the causes of negative externalities is not cost effective, levies can be placed on surrogate or proxy indicators. Potential indicators include

- The volume of water consumed;
- The number of toilets on a property;
- The number of people living in an area; and
- The sealed or impervious area associated with a property.

While attractive, the main weakness of this surrogate approach is the lesser incentive provided for people to search for innovative solutions. A toilet levy, for example, provides no incentive for people to explore opportunities to divert grey water to their garden. A levy on effluent flow does.

Reimbursing positive externalities

PERU

Some positive externalities will be created by water users because the marginal cost of their provision is zero. One obvious example is the extent of landscape amenity benefits that some people derive from a dam. Other examples include the provision of recreational benefits through the stormwater-sensitive design options mentioned earlier. As a general rule, such arrangements are seen as community service obligations. In the past, the cost of delivering such services has been seen as a community obligation. Privatisation of water supply and waste-water management processes, however, means that increasingly the marginal costs of community service provision will need to be reimbursed so that water managers have an incentive to provide them to the best of their ability.

Where the focus is on a change in attitude, voluntary mechanisms can be established. Under the Natural Heritage trust for example, communities are encouraged to apply for grants to improve the environment. Application is voluntary and acceptance of the grant is voluntary. Once all parties are committed, a contractual arrangement takes over.

Regulatory mechanisms

Regulatory mechanisms set minimum standards and, for new developments, put review processes in place. Their main weakness is the lack of incentive they provide for people to deliver more than the minimum specified. In addition, standards can be difficult to change. Once established they can be locked in. The power of regulations, however, should not be under-estimated. In particular, regulatory processes give administrators the power to negotiate for higher standards. Well administered, regulatory processes can be as efficient – if not more efficient – than many of the mechanisms described above.

As a general rule, regulations and standards associated with them reduce, but do not eliminate, externalities associated with water use (McRae *et al.*1993). Moreover, they provide little incentive for people to develop innovative solutions to emerging problems. As a basic platform from which to begin to deal with externalities, they are essential in helping to define duty of care for the environment, to establish minimum standards and to prevent backsliding.

PERU

The aim of this report was to provide a framework from which people could begin to understand the nature of externalities associated with urban water use. The first point that emerges is the need to separate

- urban water supply externalities;
- from water-use externalities;
- from wastewater return externalities; and
- from stormwater externalities.

Another critical observation is the point that water flows, per say, create few externalities. As a general rule, it is water contamination not water flow that is the problem. Actions that simply aim to reduce water flows may increase negative externalities by reducing the flows that maintain quality in many river and wetland systems.

The report also identifies a range of policy opportunities that may improve the nature of externalities. They include

- development of a water-use efficiency rating system
- introduction of a storm-water off-set mechanism

- nodal load-based licensing for the waste water treatment system, with fees charged in proportion to the load at each node and a cap on the total load that is tradeable among participants; and
- Full cost pricing for water use with rebates for the marginal cost of community service provision.

References

ABARE (1993) "Use of economic instruments in integrated coastal zone management." Consultancy Report commissioned by the Resource Assessment Commission, Canberra.

Australian Academy of Technological Sciences and Engineering (AATS&E) (1999) "Water and the Australian Economy. A joint study project of the Australian Academy of Technological Sciences and Engineering and the Institution of Engineers." Canberra, Australia.

Bowers, J (1997) "Sustainability and Environmental Economics: An alternative text." Addison Wesley Longman, Harlow.

Brunton, N. (undated) Economic instruments for water pollution: The Australian Experience. Mimeo

COAG (1999) "Incorporating externalities into water pricing." Attachment A to COAG Working Group on Water Reform Draft Paper. Agenda Item 3(c) (ii) 17th Meeting 2 July 1999.

Evangelisti & Associates, Wong,T. and Alan Tingay & Associates (1998) "A manual for managing urban stormwater quality in Western Australia." Water and Rivers Commission, August.

Gunningham, N. and Young, M.D. (1997) "Toward optimal Environmental Policy: The case of biodiversity conservation. *Ecology Law Quarterly* 24(2):243-296.

Gutteridge, Haskins and Davey (GHD) (1999) "Salinity impact study. Report to the Murray Darling Basin Commission." Canberra.

James, D. (1997) "Environmental Incentives: Australian exerience with economic instruments for environmental management." Environment Australia Environmental Economics Research Paper No. 5.

McRae, M.; Hashem, J. and Hayes, E. (1993) "Issues in balancing environmental costs and benefits in water resources planning." *Hydraulic Engineering* 1:8-14.

NSW Department of Energy (1998) "Greenhouse trading: An operational specification for the phased introduction of a nation-wide greenhouse emission-trading framework for Australia." Sydney.

PriceWaterhouseCoopers (1999) "Queensland Water Recycling Strategy: Economic Aspects of water recycling in Queensland." Department of Natural Resources, Queensland, April 1999.

Syme, G.J. (1999) "The social basis for urban water provision in the 21st Century." Australian Research Centre for Water in Society, CSIRO Land and Water. Draft CSIRO Urban Water Program Paper.

Young, M. D. (1992) "Sustainable investment and resource use: Equity, environmental integrity and economic efficiency." Parthenon Press, Carnforth and Unesco, Paris.

Young, M., Gunningham, N., Elix, J., Lambert, J., Howard, B. and Grabosky, P. (1995) "Reimbursing the Future: An Evaluation of Motivational, Price-Based, Property-Right, and Regulatory Incentives for the Conservation of Biodiversity." Department of the Environment, Sports and Territories, Canberra.

Young, M.D. (1994) "Encouraging clean production with trade waste and stormwater allowances: Options for Port Phillip Bay." Paper prepared for Altona Sustainable Development Congress, 24-27 July 1994.

Young, M.D. and Evans, R. (1997) "Right opportunity: Using right markets to manage groundwater pollution." Land and Water Resources Research and Development Corporation Occasional Paper No. 19/97.

P:\Water - urban program\reports\Final Reports for web\Managing_Externalities.doc
6-Jul-01